802.3dj D1.0
Comment Resolution - Electrical track

Adee Ran, Cisco

Introduction

- This slide package was assembled by the 802.3dj electrical editorial team to provide background and detailed resolutions to aid in comment resolution.
- Acknowledgement to Howard Heck, Adam Healey, Chris Diminico, Mike Dudek, Matt Brown, and Kent Lusted for reviewing and contributing to this work.
- Text in red indicates editors' explanation of the comments. Italics indicate an editor's observation which might be subjective.
- The responses to the comments may point to the slides for reference but the comment report is the official record.

Cross-Clause topics

Bessel-Thomson measurement filter bandwidth [15 comments, 178/179/176D/176E]

Done

Cl 178 SC 178.9.2 P275 L48 # 60

Mellitz, Richard Samtec

Comment Type TR *Comment Status* X

The Bessel-Thomson filter should track fr. Between 0.5 fb and 0.6 fb have been shown in presenations.

SuggestedRemedy

change TBD to 67GHz

Proposed Response *Response Status* O

Cl 178 SC 178.9.2 P275 L48 # 230

Li, Mike Intel

Comment Type TR *Comment Status* X

3dB BW is TBD

SuggestedRemedy

Change it to 65 GHz.
Rational, considering the common and cost effective 1.85mm connector BW, and associated ~7% measurement error, give rise to this number.

Proposed Response *Response Status* O

Cl 179 SC 179.9.4 P309 L23 # 225

Noujeim, Leesa Google

Comment Type T *Comment Status* X

Adopted baseline https://www.ieee802.org/3/dj/public/24_01/ran_3dj_01a_2401.pdf has BT filter bandwidth as TBD but D1.0 has 40GHz. 3dB bandwidth of 40GHz is insufficient for 200Gbps/lane PAM4

SuggestedRemedy

Increase to 65GHz, consistent with test equipment capabilities and demonstrated channel rolloff eg in https://www.ieee802.org/3/dj/public/23_11/weaver_3dj_01_2311.pdf and https://www.ieee802.org/3/dj/public/24_01/benartsi_3dj_01_2401.pdf OR change to TBD

Proposed Response *Response Status* O

Comment #60 is against 178.9.2 (Transmitter characteristics) and suggests **67 GHz**.
Comment #32 proposes a similar bandwidth for receiver test calibration (178.9.3.3).
The reasoning for both is that "The Bessel-Thomson filter should track fr".
Comments #131 and #133 against 176E suggest **58.4375 GHz** with similar reasoning based on different assumed f_r.

Note that there has never been a requirement to have the bandwidth of the measurement B-T filter equal to the COM f_r parameter (part of the Rx model).
(4 comments)

Comment #230 and comment #245 suggest **65 GHz** with reasoning based on connector availability.
Note that the B-T filter is implemented in the test equipment and the cost of other setup components is likely less significant.
(2 comments)

Comment #225 highlights an error in D1.0 - the value 40 GHz appears once although it has not been part of the baseline (and thus has not been adopted).
The proposed value here and in #217 is **65 GHz** based on "test equipment capabilities and demonstrated channel rolloff".
Comments #124 and #388 also address the same issue but suggest changing to **TBD**.
(4 comments)

Comments #399, #410, #412, #422, #425 suggest the value **62 GHz**.
(5 comments)

Summary: The suggested values are 58.4375, 62, 65, and 67 GHz.

Editorial team proposal: use a BW of **X** GHz for signal measurements in 178, 179, 176D, 176E. Replace all TBDs and the "40 GHz" that wasn't adopted. Proposed value for **X** is 65.

ERL (14 comments, 178/179/179B)

Done

Cl 178 SC 178.9.2.2 P 278 L 26 # 29

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

scale ERL parameter form 0.3ck

SuggestedRemedy

in table 163-7 change TBD's as follows
Tr 0.005 ns
βx 0 GHz
ρx 0.618
N 400 UI

Proposed Response *Response Status* **O**

There are several similar comments:

- #29 against 178.9.2.2 (KR Tx/Rx ERL) with N=400 (x2 of 802.3ck)
- #28 against 178.9.2.1.2 (KR test fixture ERL) with N=400 (x2 of 802.3ck)
- #43 against 178.10.3 (KR channel ERL) with N=7000 (x2 of 802.3ck)
- #48 against 179.9.4.8 (CR Tx/Rx ERL) with N=1600 (x2 of 802.3ck)
- #51 against 179.11.3 (CR cable assembly ERL) with N=4500 (**same as** 802.3ck)
- #58 against 179B.4.2 (Mated test fixtures ERL) with N=1600 (**x4** of 802.3ck), tw=1, DER0=2e-5

All propose values for ERL parameters, dividing T_r by 2 and multiplying N by as noted above, relative to the values in 802.3ck (100G).

Additional comments #237, #238, #239, #240 (Tr, beta_x, rho_x, N for KR Tx/Rx ERL, respectively) suggest some of the ERL parameters with the same values as above:

Other comments

- #241 proposes 44 for N_bx for KR Tx/Rx ERL
- #231 and #244 propose -3 dB for min dERL (KR Tx/Rx)
- #252 proposes 11 dB for min ERL (KR channel)

The justification provided for ERL parameters is very basic but may be sufficient.
(are the values of N in consensus?)
No comments address ERL parameters in Annex 176D (C2C component and channel) and 176E (C2M host and module) which are mostly TBD.

Editorial team proposal:

- Accept the suggested remedies of comments 28, 29, 43, 48, 51, 58, 241, 244, 252
- Refer 237, 238, 239, 240 to #29
- Use the suggested values from clause 178 and 179 to fill in TBDs for annex 176D and annex 176E respectively, except for the value of N and minimum ERL/dERL which will stay TBD.

ERL Tfx (5 comments, 179/176E)

Done

Cl 179 SC 179.9.4.8 P315 L35 # 227

Noujeim, Leesa Google

Comment Type T *Comment Status* X

Practical test fixtures may have discontinuities close to 0.2ns from the host-facing connection (mating interface). If the intent is to remove the test fixture discontinuities from the ERL calculations, we should adjust the 0.2ns

SuggestedRemedy

Change text to "...Tfx equal to twice the delay between the test fixture connector and the test fixture host -facing connection minus 0.2ns or as needed to remove test-fixture discontinuities from the ERL result"

Proposed Response *Response Status* O

The comment suggests that the value 0.2 ns may not be correct.

There are several similar comments:

- #227 against 179.9.4.8 (CR host transmitter ERL)
- #218 against 179.11.3 (CR cable assembly ERL)
- #219 against 179.9.5.5 (CR host receiver ERL)
- #220 against 176E.3.3.3 (C2M Host output ERL)
- #221 against 176E.3.4.2 (C2M Module output ERL)

Effect of the suggested change:

179.9.4.8 Transmitter effective return loss (ERL)

The ERL of the transmitter at TP2 is defined by the procedure in 93A.5 using the values in Table 179–9 and Table 179–15, and with the value of T_{fx} equal to twice the delay between the test fixture connector and the test fixture host-facing connection minus 0.2 ns or as needed to remove test-fixture discontinuities from the ERL result"

For module: "module-facing"
For cable assembly: "cable facing"

Note that the 0.2 in the existing text is a reduction from "twice the delay between the test fixture connector and the test fixture host-facing connection".
This means the measurement is time gated to remove reflections from the whole text fixture except for a length equivalent 0.1 ns (assuming "twice" has precedence over "minus").
0.1 ns is approximately 17 mm, so for hosts, the time-domain response starts at 17 mm before the HCB's card end, and likely includes the pad and via. Using different values may cause the via to be excluded, which may affect the ERL result.
For modules and cable assemblies, the MCB has a receptacle, which may require different time gating, but the proposal would leave Tfx open for interpretation and creates ambiguity.

Editorial team proposal: REJECT #218, #220, #227, #219, #221.

- For host ERL, the existing specification of Tfx is appropriate.
- For module and cable assembly ERL, the proposal is not specific enough.

COM (minimum/target value) [13 comments, 178/179/179A/176D]

Done

Cl 178 SC 178.10 P284 L11 # 250

Li, Mike Intel

Comment Type **TR** *Comment Status* **X**

COM(min) is TBD

SuggestedRemedy

Repalced both with 3 dB, see lim_3dj_01_2405

Proposed Response *Response Status* **O**

This comment and multiple others suggest using 3 dB as the minimum COM for channels

- 178.10 channel: #33, #250, #402, #253
- 179.11 cable assembly: #50, #413
- 176D.4 channel: #430
- 179A.7 TP0d-TP5d: #57

3 dB is also suggested for Rx test channel calibration:
178.9.3.3: #249, #400
179.9.5.3: #49, #411
176D.3.4.4: #427

The referenced presentation, https://www.ieee802.org/3/dj/public/24_05/lim_3dj_01_2405.pdf, does not include a rationale for the proposed value of COM

The minimum COM should be based on expected implementation penalty with respect to the new reference receiver, for which many parameters are TBD. Specifically, the presentations https://www.ieee802.org/3/dj/public/24_05/healey_3dj_01b_2405.pdf and https://www.ieee802.org/3/dj/public/24_05/shakiba_3dj_02_2405.pdf are relevant in this context.

However, the same value is proposed in several comments, so it may be in consensus and enable moving forward.

Editorial team proposal: Use the value **X** for minimum COM for channels and for test setup calibration in KR/CR/C2C.
Proposed value for X is 3 dB.

Reference impedance for specifications [2 comments, 178/179]

Done

Cl **178** *SC* **178.9.1** *P* **275** *L* **39** # 395

Kocsis, Sam — Amphenol

Comment Type **T** *Comment Status* **X**

The reference impedance should match the system impedance, Rd as defined in COM spreadsheets.

SuggestedRemedy

92-ohm, TBD, or straw poll based on proposed values presented in Task Force contributions

Proposed Response *Response Status* **O**

2 comments (#395, #387) about the reference impedance for specifications suggest that it should match the system impedance, and that 46 Ohm (92 Ohm differential) is a possible value.

The reference impedance for specifications (not R_0) affects ERL and other RL results (S-parameter values depend on the reference impedance), and if test equipment is matched to this impedance it will also affect time-domain measurements (R_peak, SNR_ISI).
Designs may take this into consideration, and it would be preferable if these specs do not penalize components matched to the "system impedance" (assumed impedance of the other system components). ⇒ see next slide.

178.9 Electrical characteristics

178.9.1 Reference impedance

The reference impedance for differential specifications is 100 Ω. The reference impedance for common-mode specifications is 25 Ω.

COM R_d parameter
[8 comments, 178/179/176D/176E]

Done

Cl 178 SC 178.10.1 P285 L40 # 396

Kocsis, Sam Amphenol

Comment Type T *Comment Status* X

Rd(t) = "TBD"

SuggestedRemedy

Change "TBD" to "92-ohm" to match majority of contributions to the Task Force, and better align with Zc definition in package

Proposed Response *Response Status* O

This comment and 3 similar ones (#396, #397, #391, #392) are about the R_d parameter, which is used as the terminations (Tx and Rx) in the COM pulse response calculation.
The value in the suggested remedy seems to be differential, and would become 46 Ohm single ended.

Other comments suggest different values:
- #255, #256: 46.25 Ohm
- #141, #137: 50 Ohm

The value of R_d affects the reference ERL (and thus dERL) and the reflections within the reference package (and thus COM and dR_peak).

*ERL is also affected by the **reference impedance for measurements** (which is now, effectively, 50 Ohm single-ended - see previous slide) so these specifications are closely tied with each other.*

Note that if R_d is different from the termination used in time-domain measurements (e.g. scope) then A_v, A_fe and A_ne need to change to create the minimum compliant v_f when measured on a scope. Additionally, Tx output specifications may need to be changed.

Editorial team proposal:
- Change Rd (both t and r) from TBD to **X Ohm** in COM device parameters tables (Table 178–12, Table 179–15, Table 176D).
- Change the reference impedance statements (178A.1.3, 178.9.1, 179.9.3, 179.11.1, and 176D.3.2) to define a reference **single-ended** impedance of **X Ohm** for all specifications, e.g., insertion loss, return loss, and ERL. Add a similar statement in 176E.

Proposed value for X: 46 Ohm.

If X is different from 50 Ohm, add a NOTE that s-parameter measurements may be made with a different impedance and converted mathematically to that reference. Add an editor's note that output waveform measurements on 50 Ohm scopes need to be addressed.

If the reference impedance is different from R_d, add an editor's note after each COM parameter table, noting that the values of A_v, A_ne and A_fe need confirmation.

COM R_0 parameter
[9 comments, 178/179/176D/176E]

Done

Cl **178** *SC* **178.10.1** *P* **285** *L* **38** # 35

Mellitz, Richard — Samtec

Comment Type **TR** *Comment Status* **X**

(Table 178–12): Computation can be independent of R0. Add a note to explain. S parameter can utilize any R0. For computation purposes s-parameters are converted to 50 ohms which is the native impedance for the most common test equipment.

SuggestedRemedy

Change R0 for TBD to 50 ohms and add a note indicating the imported s-parameter are to be converted into 50 ohm reference before computation.

Proposed Response *Response Status* **O**

2 comments (#35, #52) suggests that R_0 should not affect COM result.

7 comments (#254, #403, #414, #141, #431, #136, #438) suggest the value 50 Ohm for R_0, as used in previous projects.

Note that the reference impedance for specifications is stated explicitly in 178.9.1, 179.9.3, 179.11.1, and 176D.3.2 (see previous slide), and does not refer to R_0.

178A.1.3 already defines the reference impedance for s-parameters (effectively 50 Ohm single ended). We should consider defining the value fo R_0 and the reference impedance for s-parameters once (as one parameter).

178A.1.3 Measurement of the channel under test

The S-parameters for each signal path are measured between the test points specified by the clause or annex that utilizes this calculation. It is recommended that the scattering parameters be measured with a uniform frequency step from a start frequency no greater than 10 MHz (TBC) to a stop frequency of at least TBD GHz. The measurement frequency step corresponds to the time span of the pulse response derived from the S-parameters (see 178A.1.6). The frequency step should be chosen to be small enough so that all significant components of the pulse response are included.

The reference impedance for the measurement of differential-mode S-parameters is 100 Ω.

Editorial team proposal:
Align the value of R_0 with the reference impedance for specifications in all COM tables. Use the table as a specification and refer to it from the subclauses that define the reference impedance for specifications (178.9.1, 179.9.3, 179.11.1, 176D.3.2).
Delete the statement about reference impedance for measurements of S-parameters in 178A.1.3.
Add an informative NOTE as in the suggested remedy in those subclauses.

COM Tx FFE
[10 comments, 178/179/176D/176E]

Done

Cl 178 SC 178.10.1 P286 L18 # 37

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

Presentations so for have not shown the need for Tx FFE. Change to no TXFFE until further data is provided.
Rx noise may suggest a need for the TXFFE which would improve performance. It's not clear from a channel perspective that the TX FFE is not a zero sum gain compared to the Rx noise loss of COM. Until Rx FFE noise is better defined zero out TxFFE.

SuggestedRemedy

Change TBDs for c(-3),c(-2),c(-1), and c(1) to zero. Set C(0) tp 1.

Proposed Response *Response Status* **O**

The comment suggests that COM should use no Tx equalization.

The contributions so far are not sufficient evidence for not needing a Tx FFE as suggested in comment #37. The chosen Tx FFE values ("no equalization") in analysis presented so far is due to the unlimited Rx FFE coefficients used in the analysis, but these limits are still TBD. The possible inclusion of an ADC model (with dynamic-range-dependent quantization noise), presented in https://www.ieee802.org/3/dj/public/24_05/healey_3dj_01b_2405.pdf, may change the chosen Tx FFE.

There are several proposals in different sets of comments on the same topic
However, it may be possible to reach consensus and enable moving forward.

Coefficient	#37 (C178)	#142, #138 (A176D, A176E)	#258-#262 (C178)	#405, #416 (C178, C179)
c(-3)	0	-	-	-0.06 : 0.02 : 0
c(-2)	0	0 : 0.02 : 0.14	0 : 0.02 : 0.16	0 : 0.02 : 0.12
c(-1)	0	-0.3 : 0.02 : 0	-0.4 : 0.02 : 0	-0.34 : 0.02 : 0
c(0)	1	0.65	0.54	0.5
c(1)	0	-0.14 : 0.02 : 0.14	-0.2 : 0.02 : 0	-0.2 : 0.02 : 0

Editorial team proposal:
- Adopt the highlighted values in the tables above for the COM tables in 178, 179, 176D, and 176E
- no c(-3)

COM f_r parameter
[9 comments, 178/179/176D/176E]

Done

Cl 178 SC 178.10.1 P286 L12 # 36

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

T(able 178–13) Presentations so far have used fr of 0.5, 0.55, 0.58, and 0.6. 67 Ghz limits on test equipment and cabling/connector modal physics suggest at least a 9 dB loss is required for good measurements at 67 GHz. Set fr to 0.6 or lower to achieve this.

SuggestedRemedy

change TBD to 0.6.

Proposed Response *Response Status* **O**

Comment #36 suggests that the values 0.5, 0.55. 0.58 and 0.6 are candidates, and suggests 0.6.
The suggested relationship between f_r and measurement bandwidth has not been established.

Several values are suggested in various comments:

- #36, #53: 0.6
- #404, #415, #432, #439: 0.58 (no rationale)
- #137, #141: 0.55 (no rationale)
- #257: 0.5 (refers to lim_3dj_01_2405, but no rationale in this presentation)

Previous reference receivers used the value 0.75, but several past contributions suggest that a lower value would both be more realistic and yield better COM results.
No comment suggests that there should be a difference between interfaces.

With not-too-different values proposed in several comments, it may be possible to reach consensus and enable moving forward.

Editorial team proposal:
Use f_r = **X***f_b as reference receiver bandwidth for all electrical interfaces (Table 178-13, Table 179-16, Table 176D-6, and Table 176E–7).
Proposed value of X: 0.55

COM Rx FFE length parameters [9 comments, 178/179/176D/176E]

Done

Cl 178 SC 178.10.1 P287 L13 # 275
Li, Mike Intel
Comment Type TR Comment Status X
Nfix TBD
SuggestedRemedy
Replace it w 24,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

Cl 178 SC 178.10.1 P287 L16 # 277
Li, Mike Intel
Comment Type TR Comment Status X
Nf TBD
SuggestedRemedy
Replace it w 5,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

Cl 178 SC 178.10.1 P287 L13 # 274
Li, Mike Intel
Comment Type TR Comment Status X
dw TBD
SuggestedRemedy
Replace it w 6,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

Cl 178 SC 178.10.1 P287 L17 # 278
Li, Mike Intel
Comment Type TR Comment Status X
Namx TBD
SuggestedRemedy
Replace it w 60,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

Cl 178 SC 178.10.1 P287 L15 # 276
Li, Mike Intel
Comment Type TR Comment Status X
Ng TBD
SuggestedRemedy
Replace it w 4,
see lim_3dj_01_2405, slide 5
Proposed Response Response Status O

5 separate comments against COM Rx FFE length parameters in clause 178:
- d_w (#274)
- N_fix (#275)
- N_g (#276)
- N_f (#277)
- N_max (#278)

Comments #42 (178) and #54 (179) suggest multiple choices for many parameters (not a specific proposal).

Comment #140 proposed Rx FFE parameters for 176E reference receiver, and #144 proposes the same parameters for C2C COM reference receiver.

Comments #504 (176D), #70 (179), #71 (178), and #72 (176E) propose values for some of these parameters along with many others.

Additional proposals for these parameters are included in consensus presentations, see https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_07_2405.pdf and https://www.ieee802.org/3/dj/public/24_06/lusted_3dj_01a_2406.pdf

Editorial team proposal:
Use d_w=5 (as proposed in lusted_3dj_07_2405), N_fix=14, N_g=2, N_f=4, and N_max=50 (as proposed in lusted_3dj_01a_2406) to replace TBDs in Table 176D–7 and Table 176E–7.
Add editor's notes similar to that in slide 4 of lusted_3dj_07_2405 and slide 5 of lusted_3dj_01a_2406 to denote that these values need further analysis.
Keep these values TBD in clauses 178 and 179.

COM Rx FFE and DFE coefficient limits [14 comments, 178/179/176D/176E]

Done

Cl 178 SC 178.10.1 P287 L18 # 279

Li, Mike Intel

Comment Type **TR** *Comment Status* **X**

Wamx(j) TBD

SuggestedRemedy

Replace it w 0.7,
see lim_3dj_01_2405, slide 5

Proposed Response *Response Status* **O**

The referenced presentation, lim_3dj_01_2405, does not include an explanation of the proposed value.

4 separate comments against COM Rx FFE coefficient limits in clause 178:
- Wmax: 0.7 (#279) and Wmin: -0.7 (#280)
- bmax : 0.85 (#281) and bmin: 0.3 (#282)
- Floating tap min/max (#283 and #284)

For bmax, comment #140 (176E) and #144 (176D) propose 0.75 (but also d_w)

Comments #42 (178) and #54 (179) suggest multiple choices for many parameters (not a specific proposal).

Comments #504 (176D), #70 (179), #71 (178), and #72 (176E) propose values for some of these parameters along with many others.
The presentation https://www.ieee802.org/3/dj/public/24_05/heck_3dj_01b_2405.pdf was provided in support of #504. Slides 25-26 include proposed values for Wmin/Wmax (per index) and Bmax=0.75

A wide range allowed for FFE coefficients, combined with not accounting for quantization noise, effectively assumes a high-resolution ADC and causes the Tx FFE coefficients not to be utilized in COM optimization. This implies that receivers do not need Tx equalization. The penalties of real receivers having more limited FFE equalization, which would some Tx equalization, have not been analyzed.
Further analysis in this area is encouraged.

However, if consensus can be achieved, having numbers instead of TBDs is a step forward.

Editorial team proposal:
Use the proposed values of w_max, w_min, b_max, b_min in comments #279-#282 to replace TBDs in COM tables in 178, 179, 176D, and COM table + reference receiver in 176E.
Add editor's notes similar to that in slide 4 of https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_07_2405.pdf to denote that these values need further analysis.

COM CTLE parameters [6 comments, 178/176D/176E]

Done

Cl 178 SC 178.10.1 P286 L32 # 263

Li, Mike Intel

Comment Type TR *Comment Status* X

g1 inherited from 802.3ck, no simod support, not approproaite

SuggestedRemedy

Replace them w
-15 :0, 1 (min, max, step)
see lim_3dj_01_2405, slide 5

Proposed Response *Response Status* O

Cl 176D SC 176D.4.1 P606 L33 # 433

Li, Tobey MediaTek

Comment Type TR *Comment Status* X

Zero 2 frequency and pole 3 frequency of Continuous time filter are inconsistent with Table 178–13

SuggestedRemedy

Replace zero 2 frequency with fb/80
Change pole 3 frequency from "fb" to "fb/80"

Proposed Response *Response Status* O

Cl 176E SC 176E.5.2 P634 L34 # 440

Li, Tobey MediaTek

Comment Type TR *Comment Status* X

Pole & zero frequency values of continuous time filter are TBD

SuggestedRemedy

Replace zero 1 frequency, fz1, with fb/2.5 GHz
Replace zero 2 frequency, fz2, with fb/80 GHz
Replace pole 1 frequency, fp1, with fb/2.5 GHz
Replace pole 2 frequency, fp2, with fb GHz
Replace pole 3 frequency, fp3, with fb/80 GHz

Proposed Response *Response Status* O

4 separate comments against COM CTLE parameters in Table 178-13 (non-TBD):

- g1: -15:1:0 (#263) (-15 instead of -20)
- g2: -5:1:0 (#264) (-5 instead of -6)
- fz1, fz2: fb/4.233, fb/80 (#265) (fb/4.233 instead of fb/2.5)
- fp1, fp2, fp3: fb/1.8973, fb/2.6562, fb/80 (#266) (fb/1.8973 instead of fb/2.5 and fb/2.6562 instead of fb)

The referenced presentation https://www.ieee802.org/3/dj/public/24_05/lim_3dj_01_2405.pdf does not include a rationale for the proposed changes (highlighted) to the existing values of these COM parameters, nor clarifies why they should be made different from those of clause 179.

Comment #433 suggests changes in Table 176D–6 (C2C) to align it with Table 178-13 (KR)

- Suggests fz2 = fb/80 (replacing TBD)
- Suggests fp3 = fb/80

Comment #440 suggests CTLE parameters for the C2M reference receiver in Table 176E–7 (all currently TBD) that are aligned with the COM parameters of clause 178 and 179.

In addition, the editorial team noticed that Table 176D-7 includes the parameter fLF which is not defined in Annex 176A (it is replaced by fp3 and fz2).

Editorial team proposal:

- Use the identical CTLE parameters from Table 178-13 and Table 179-16, without change, in C2C (Table 176D-6) and C2M (Table 176E–7)
- Align fp1, fz1, fp2, fz2, fp3 in all tables
- Remove fLF from Table 176D-7

(AIP #433, AIP #440, REJECT #263-#266)

COM T_r parameter
[6 comments, 178/179/176D/176E]

Done

Cl 179 SC 179.10.1 P286 L50 # 39

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

scale Tr from .3ck. Understand that this is not the Tr at TP0d.

SuggestedRemedy

set Tr to 0.00375 ns

Proposed Response *Response Status* **O**

This comment suggests that the transition time T_r used in COM should be scaled down from the value 7.5 ps used in 802.3ck, resulting in 3.75 ps; and states that “this is not the Tr at TP0d”.

Other comments (#268, #407, #418, #435, #441) suggest the value 4 ps instead.

Note that T_r (modeled prior to the device termination) contributes to the transition time at TP0d (after the device termination), and will therefore affect Tx specifications at TP0v (specifically, the reference R_peak). The sensitivity of these specifications to the suggested values of T_r (combined with the device and package model) has not been addressed by any contributions. Further analysis in this area is encouraged.

However, having numbers instead of TBDs is a step forward, if consensus can be achieved.

Editorial team proposal:

- Change T_r from TBD to **X** ps in Table 178–13, Table 179–15, Table 176D–7, and Table 176E–7.
- Add editor's notes similar to that in slide 4 of https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_07_2405.pdf to denote that this value needs further analysis.

Proposed value of X: 4

SNDR/SCMR/SNR_TX
[6 comments, 178/179]

In agenda

Cl 179 SC 179.9.4.1.1 P312 L42 # 45

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

SNDR reduces with loss and used that way for equation 178A–18.

SuggestedRemedy

Insert a subsection e) Loss correction factor for fitted pulse measurements. See presentation

Proposed Response *Response Status* **O**

Cl 179 SC 179.9.4.6 P315 L17 # 47

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

SNDR reduces with loss and used that way for equation 178A–18.

SuggestedRemedy

change
The transmitter SNDR is defined by the measurement method described in 120D.3.1.6
to
The transmitter SNDR is defined by the measurement method described in 120D.3.1.6 plus a power loss factor defined in xxxx

Proposed Response *Response Status* **O**

If the proposal is adopted, implementing this proposal would preferably done with broad editorial license.

Other comments (shown on subsequent slides) are based on this proposed change.

The following presentation was reviewed by the task force at the May interim meeting:
https://www.ieee802.org/3/dj/public/24_05/mellitz_3dj_02_2405.pdf
The presentation suggested effectively changing the definition of the "signal" component of SNDR as shown in the excerpts below.
The motivation is that this way the SNDR measurement at different losses between the source and the measurement point yield consistent results.

The presentation suggests a specific way of writing this definition as a correction factor "So we don't change prior standards", but this can be done specifically for the clauses in this project without affecting other standards.

Comment #47 seems to suggests essentially the same change.

- For the "S" in SNDR use the power variance of the signal at the measurement point as follows which is the in time and frequency domain
  - $\sigma_P^2 = \sum_1^{\mathrm{M}(N_p - Dp - 1)} p(n)^2$
  - Instead of p_{max}
- Consider SNDR as a ratio of signal power variance to noise power variance
  - Perhaps: SNDR should be $10 * log_{10}\left(\frac{\sigma_P^2}{\sigma_e^2 + \sigma_n^2}\right)$

SNDR/SCMR/SNR_TX [6 comments, 178/179]

In agenda

Cl 178 SC 178.9.2 P276 L34 # 27

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

adjust SNDR with loss correction factor which is about 1 dB basd on prior assumptions

SuggestedRemedy

change SNDR to 33.5 dB.

Cl 178 SC 178.10.2 P287 L5 # 41

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

SNR_TX can be SNDR when loss correction is employed

SuggestedRemedy

Change TBD to 33.5 dB

Proposed Response *Response Status* **O**

Cl 178 SC 178.9.2.6 P279 L22 # 31

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

adjust SCMR with loss correction factor

SuggestedRemedy

add + loss correction factor to equation 178-1

Proposed Response *Response Status* **O**

- #27 suggests setting the minimum SNDR in clause 178 to 33.5 dB based on the expected improvement from the new definition.
- #41 suggests using the same value for SNR_TX.
- #31 suggests that the correction factor (essentially the new numerator) be applied to SCMR in clause 178.
- #270 suggests 33 dB for SNDR in clause 178 (not related to the proposed redefinition of SNDR).

Editorial team proposal:
For #45:

- Change the definitions of SNDR in 179.9.4.6 and SCMR in 178.9.2.6 to use a numerator based on the suggested equations in https://www.ieee802.org/3/dj/public/24_05/mellitz_3dj_02_2405.pdf slides 12 and 13, with editorial license.
- Change SNDR (min) to **X** in transmitter characteristics in 178, 179, and 176D.
- Change SNR_TX in COM tables to **X**.

Suggested value for **X**: 33.5 dB.

#47, #31, #27, #41, #270: resolve using the response to #45.

Jitter
[4 comments, 178/179]

Done

Cl 178 SC 178.9.2 P276 L38 # 236

Li, Mike Intel

Comment Type TR *Comment Status* X

Output jitter (max) TBD

SuggestedRemedy

reapcle TBDs with:
Jrms : 0.023 UI
J2.7u03: 0.102 UI
J2.7u: 0.110 UI
Even--odd jitter, pk-pk: 0.025 UI
See lim_3dj_01_2403a, lim_3dj_01_2405, and [1], [2], [3]

Proposed Response *Response Status* O

Cl 179 SC 179.9.4.7 P310 L25 # 204

Ran, Adee Cisco

Comment Type TR *Comment Status* X

Jitter specification is TBD.

Based on https://www.ieee802.org/3/dj/public/adhoc/electrical/24_0104/calvin_3dj_elec_01a_240104.pdf, the jitter measurement methodology of existing clauses 162, 163, and 120G (specifically using the two edges R03/F30) is feasible for measurements with a loss 30 dB. It is expected that the same method can be used for higher losses as long as the scope can maintain CDR lock.

This methodology should be used for all electrical interfaces, with adequate adjustments.

SuggestedRemedy

A detailed proposal will be provided.

Proposed Response *Response Status* O

- #236 refers to the following presentations: https://www.ieee802.org/3/dj/public/24_03/lim_3dj_01a_2403.pdf, https://www.ieee802.org/3/dj/public/24_05/lim_3dj_01_2405.pdf
- #204 refers to https://www.ieee802.org/3/dj/public/adhoc/electrical/24_0104/calvin_3dj_elec_01a_240104.pdf and the detailed proposal mentioned is https://www.ieee802.org/3/dj/public/24_05/ran_3dj_03_2405.pdf.
- #271 and #272 suggest A_DD=0.02 UI and sigma_RJ=0.01 UI.

Both #236 and #204 (in ran_3dj_03_2405) suggest using jitter specifications based on the dual-Dirac model with parameters in #271 and #272. As a result, both proposals have approximately the same JRMS. EOJ is also similar.

The main difference is that comment #236 suggests using a new parameter J2.7u, while #204 (in ran_3dj_03_2405) suggests using J3u and J6u, measured only on the R03/F30 edges.

Additional relevant presentation was reviewed in the May interim meeting: https://www.ieee802.org/3/dj/public/24_05/zivny_3dj_01a_2405.pdf, suggesting changes to the measurement method to potentially improve the precision. The following straw poll was taken after the presentation:

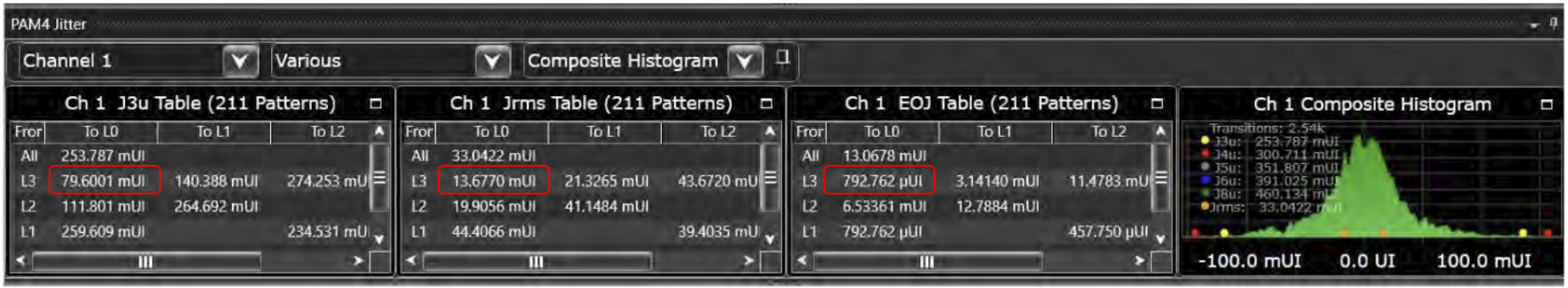
Straw Poll #8
I would support the approach for the C2M and CR measurement specifications in zivny_3dj_01a_2405
Y: 12, N: 11 , NMI: 22 , A: 36

The results show support for the proposed jitter measurement methodology changes, but consensus is not obvious.

Jitter (cont.)
[4 comments, 178/179]

Done

Based on the results reported on slide 7 of zivny_3dj_01a_2405, it is technically feasible to make jitter measurements after a channel with 33 dB IL using the “large transitions” (e.g. L3 to L0). Including smaller transitions would degrade the results.



In previous projects we had slightly higher J3u/J3u03 limits at TP2 (CR) than in TP0a/TP0v (KR/C2C), to account for degradation due to the host channel loss.

Table 163-5

Jitter (max)[c]			
J_{RMS}	162.9.4.7	0.023	UI
$J3u_{03}$	162.9.4.7	0.106	UI
J3u	162.9.4.7	0.115	UI
Even-odd jitter, pk-pk	162.9.4.7	0.025	UI

Table 162-11

Output jitter (max)			
J_{RMS}	162.9.4.7	0.023	UI
$J3u_{03}$	162.9.4.7	0.115	UI
J3u	162.9.4.7	0.125	UI
Even-odd jitter, pk-pk	162.9.4.7	0.025	UI

In this project we have **two** Tx package classes for TP0v and **three** host classes for TP2 with different loss to the measurement test point.
Following the same reasoning, the jitter specs may be different in each case.

Jitter (cont.)
[4 comments, 178/179]

Done

A possible set of limits for measurements using only R03/F30 transitions is shown in the tables below.
The highlighted values are the same as in 802.3ck KR/CR.

Interface	Max J_{RMS}	Max EOJ	Max J3u	Max J6u
C2C and KR transmitter class A (TP0v)	0.023	0.025	0.106	0.138
C2C and KR transmitter class B (TP0v)	0.023	0.025	0.108	0.140
CR transmitter, host-low (TP2)	0.023	0.025	0.115	0.147
CR transmitter, host-nom (TP2)	0.023	0.025	0.122	0.154
CR transmitter, host-high (TP2)	0.023	0.025	0.128	0.160

Interface	Max J_{RMS}	Max EOJ	Max J3u	Max J6u
C2M module output (TP4)	0.023	0.025	0.106	0.138
C2M host output (TP1a)	0.023	0.025	0.124	0.156

To unify and simplify the specifications, it is suggested that the combination of J3u and J6u is sufficient for AUI specifications; there is no need to specify J4u (or similar specs) for AUI-C2C, nor for AUI-C2M.

Editorial team proposal:
- Adopt the COM parameter values A_dd=0.02 and sigma_RJ=0.01 for all COM tables.
- For clauses 178 and 179 and Annex 176D, adopt the limits in the left table, measured only on R03/F30 edges, for the following parameters:
  - JRMS
  - EOJ
  - J3u
  - J6u
- For Annex 176E (comments #186 and #187), adopt the limits in the right table.
- Add editor's notes that the jitter limits need confirmation.
- For measurement over all 12 edges, encourage additional contributions for feasible values.

Pulse response linear fit
[5 comments, 178/179/176E]

In agenda

Cl 178 SC 178.9.2.4 P279 L4 # 30

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

The baud rate has doubled from .3ck,. If loading is scaled down with the baud rate, the physical setting time would remain unchanged. Adjust Nv and Dp accordingly.

SuggestedRemedy

Change Nv=TBD to Nv=400

Proposed Response *Response Status* **O**

Cl 178 SC 178.9.2.4 P278 L4 # 243

Li, Mike Intel

Comment Type **TR** *Comment Status* **X**

Nv is TBD

SuggestedRemedy

repalce it with 400, seelim_3dj_01_2403a

Proposed Response *Response Status* **O**

Cl 179 SC 179.9.4.1.2 P312 L53 # 46

Mellitz, Richard Samtec

Comment Type **T** *Comment Status* **X**

scale Nv from .3ck

SuggestedRemedy

change Nv to 400

Proposed Response *Response Status* **O**

Nv=400

Cl 179 SC 179.9.4.1.1 P312 L2 # 44

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **X**

The baud rate has doubled from .3ck,. If loading is scaled down with the baud rate, the physical setting time would remain unchanged. Adjust Np and Dp accordingly.

SuggestedRemedy

Change Np from 200 to 400. change Dp from 4 to 8.

Proposed Response *Response Status* **O**

Cl 176E SC 176E.5.2 P635 L35 # 444

Li, Tobey MediaTek

Comment Type **TR** *Comment Status* **X**

"Dp equal to 3" is not right as there are 3 pre-taps for the host

SuggestedRemedy

Change "Dp equal to 3" to "Dp equal to 4"

Proposed Response *Response Status* **O**

Dp 4/8
Np=400

Pulse response linear fit (cont.) [5 comments, 178/179/176E]

In agenda

179.9.4.1.2 Steady-state voltage and linear fit pulse peak ratio

The linear fit pulse peak v_{peak} and steady-state voltage v_f are defined using the linear fit pulse response $p(1)$ through $p(M \times N_v)$, measured with transmit equalizer set to preset 1 (no equalization). N_v is set equal to 200. The linear fit procedure for obtaining $p(k)$ and the values of M and N_p are defined in 179.9.4.1.1.

178.9.2.4 Difference steady-state voltage

The difference steady-state voltage of the transmitter at TP0v is computed using the procedure in 163A.3.2.1 with N_v = TBD and other parameter values specified in Table 178–12. The reference value, $v_f^{(ref)}$, is calculated based on the receiver package class to which the device adheres.

The difference steady-state voltage at TP0v shall meet the specification dv_f(min) in Table 178–6.

176E.5.2 Output signal measurement method

<...>

Perform the following steps for each valid combination of g_{DC} and g_{DC2} as specified in Table 176E–7:

b) Compute the response $y_2(k)$ by applying the effect of the continuous time filter to $y_1(k)$ using the associated parameters in Table 176E–7.

c) Compute the linear fit pulse response $p_2(k)$ using the method defined in 179.9.4.1.1 with parameter M the same as for step a), D_p equal to 3, and N_p equal to 200.

179.9.4.1.1 Linear fit to the measured waveform

<...>

Compute the linear fit pulse response $p(k)$ and linear fit error $e(k)$, k=1 to $M \times N_p$, from the captured waveform, as specified in 85.8.3.3.5, with N_p = 200 and D_p = 4 where the aligned symbols $x(n)$ are assigned normalized amplitudes −1, −*ES*, *ES*, and 1 to represent the PAM4 symbol values 0, 1, 2, and 3 respectively. *ES* is defined as (|*ES1*| + |*ES2*|)/2 where *ES1* and *ES2* are calculated according to 120D.3.1.2.

D_p is the number of precursor in the linear fit and has traditionally been the 1 plus the number of precursor Tx FFE taps, enabling measurement of the coefficients.

N_p is the linear fit pulse response length in UI.
N_v is the length in UI taken for calculation of the steady-state voltage v_f.

Parameter	137.9.2, 120D.3.1	136.9.3.1	(163.9.2.4)	(162.9.4.1)
Np	200	200	200	200
Nv	13	13	200	200
Dp	2	3	4	4

Editorial team proposal:
Use Np=200, Nv=200, and Dp=4 for all interfaces.
In 178.9.2.4, change TBD to 200.

RX ITOL/JTOL Comment #246

In agenda

Cl 178 SC 178.9.3.3 P282 L12 # 246

Li, Mike Intel

Comment Type **TR** *Comment Status* **X**

FEC symbol error ratio is not aligned with DER value

SuggestedRemedy

change it to 2e-3

Proposed Response *Response Status* **O**

Table 178–10—Receiver interference tolerance parameters

Parameter	Test 1 (low loss)			Test 2 (high loss)			Units
	Min	Max	Target	Min	Max	Target	
FEC symbol error ratio[a]	—	$< 10^{-3}$	—	—	$< 10^{-3}$	—	—

The comment addresses an inconsistency between FEC SER and DER.
This is a cross-clause topic:

- For CR, the same value 1e-3 appears in Table 179-11.
- For C2C, Table 176D-4 has TBD instead.
- For C2M, the stressed input subclauses 176E.3.5.5 and 176E.3.6.5 have “The host under test shall meet the requirements in 176E.2”...
  - 176E.2 says “A 200 Gb/s per lane AUI-C2M component shall meet the error ratio requirements specified in 174A.X when it operates in DATA mode”.

In conjunction with this topic, comment #205 has been resolved with an update of Annex 174A which will specify the data reliability requirement from PMDs and AUIs using the probability of uncorrectable FEC codewords with additional errors (option B). See ran_3dj_04a_2405 slide 11 (PMDs) and slide 13 (AUIs).

The response to #205 says “Update clauses/annexes 171, 178, 179, 179D, 179E, 180 to 183, 185, 187 appropriately”.
The updates of electrical clauses/annexes will include the receiver test requirements.

Editorial team proposal:
Resolve #246 using the response to comment #205.

RX ITOL/JTOL
Comment #177

In agenda

Cl 179 SC 179.9.5.4.2 P323 L38 # 177

Ramesh, Sridhar Maxlinear Inc

Comment Type **TR** *Comment Status* **X**

Table 179-12: Jitter mask extended below 40Khz and above 40MHz for completeness

SuggestedRemedy

Case A - please amend to <= 0.04, Case F, please amend to >= 40

Proposed Response *Response Status* **O**

A PHY shall meet the FEC symbol error ratio requirement defined in Table 179–11 for each pair of jitter frequency and peak-to-peak amplitude values listed in Table 179–12 with jitter added to all lanes.

Table 179–12—Receiver jitter tolerance parameters

Parameter	Case A	Case B	Case C	Case D	Case E	Case F	Units
Jitter frequency	≤ 0.04	0.4	1.333	4	12	≥ 40	MHz
Jitter amplitude (pk-pk)	5	0.5	0.15	0.05	0.05	0.05	UI

The comment suggests changes in the jitter tolerance parameters as shown.
This is a cross-clause topic as the table is referenced from KR, C2C, and C2M jitter tolerance requirements.

The cases in the table are specific frequency/amplitude combinations defined as requirements for compliance, rather than specifying amplitude as a continuous function of frequency. This approach has been used in 802.3 in all jitter tolerance requirement at 50G/lane and higher, and enables well-defined and bounded compliance requirements.

The test cases were selected with the intent of matching the transmitter jitter specifications with consideration of common jitter sources. Further information on this topic can be found in maintenance request 1385, see https://www.ieee802.org/3/maint/requests/maint_1385.pdf.

It is unclear what concerns would be addressed by the proposed change.

Editorial team proposal:
Reject comment #177.

Multiple COM parameters [6 comments, 178/179/176D/176E]

Cl 179 SC 179.11.7 P 332 L 12 # 70

Lusted, Kent — Intel Corporation

Comment Type TR *Comment Status* X

The COM parameter values for the 200GBASE-CR1, 400GBASE-CR2, 800GBASE-CR4 and 1.6TBASE-CR8 PMDs are TBDs

SuggestedRemedy

In table 179-16, Use the COM parameter values from https://www.ieee802.org/3/dj/public/24_01/healey_3dj_01_2401.pdf slide 18, which are:

f_r = 0.58
c(-3) = 0
c(-2) = 0
c(-1) = 0
c(0) = 1
c(1) = 0
A_v = 0.413
A_fe = 0.413
A_ne = 0.45
eta_0 = 6e-9
SNR_TX = 33
sigma_RJ = 0.01
A_DD = 0.02
R_LM = 0.95
d_w = 5
Nfix = 10
N_g = 0
N_f = 0
N_max = 0
b_max(1) = 0.85
b_min(1) = 0

additionally, set MLSE = 0 (not enabled)

Proposed Response *Response Status* O

Comments #70 and #71 propose a large set of COM parameter values together for CR and KR, respectively.
Comment #72 proposes a similar set for C2M and suggests adding a table instead of referring to the parameters of C2C.

The referenced presentation, https://www.ieee802.org/3/dj/public/24_01/healey_3dj_01_2401.pdf, does not provide rationale for the suggested remedies of these comments. Specifically, slide #18 states that the values used are not a baseline proposal.

Comment #504 proposes a set of parameters for C2C, following analysis in https://www.ieee802.org/3/dj/public/24_05/heck_3dj_01b_2405.pdf.
Comments #42 and #54 do not include a specific proposal (but suggest a series of straw polls).

There are multiple other comments that may result in adopting values for some of the proposed parameters. These comments may to be resolved partially by the responses to the other comments.

Note that the presentations cited did not examine the effect of constraining the Rx FFE parameters (Wmin/Wmax), and disabled Tx equalization (c(i)). The assumption that receiver can operate with large Rx FFE coefficient values and without Tx FFE equalization may not be in consensus.

Editorial team proposal:
- REJECT comments #42 and #54 (no actionable remedy within the draft).
- Resolve the other comments after all other electrical comments, to possibly adopt values for parameters that have not been addressed by other comments and may be in consensus.
- Consider adding a COM table in Annex 176E as suggested by comment #72.
- If necessary, add editor's notes similar to that in slide 4 of https://www.ieee802.org/3/dj/public/24_05/lusted_3dj_07_2405.pdf to denote values that need further analysis.

Clause 178

Clause 178, RLcc (#232, #242)

In agenda

Cl 178 SC 178.9.2 P276 L20 # 232

Li, Mike Intel

Comment Type **TR** *Comment Status* **X**

RLcc (min) is TBD

SuggestedRemedy

Change it to 3.25 dB. See lim_3dj_01_2403a.

Proposed Response *Response Status* **O**

Cl 178 SC 178.9.2.3 P278 L46 # 242

Li, Mike Intel

Comment Type **TR** *Comment Status* **X**

mac freq is TBD

SuggestedRemedy

repalce it with 80 GHz, see lim_3dj_01_2403a

Proposed Response *Response Status* **O**

The referenced presentation (200G/Lane KR Baseline for 802.3dj, https://www.ieee802.org/3/dj/public/24_03/lim_3dj_01a_2403.pdf) does not include an explanation of the proposed values.

The value suggested by #232 is the same as in 802.3ck, Table 163–5.

Table 178–6—Summary of transmitter specifications at TP0v

Common-mode to common-mode return loss, *RLcc* (min)	178.9.2.3	TBD	dB

178.9.2.3 Transmitter common-mode to common-mode return loss

The common-mode to common-mode return loss shall be greater than or equal to *RLcc* (min) in Table 178–6 at all frequencies between 0.2 GHz and TBD GHz.

Editor's note (to be removed by D2.0, or if values are adopted):
Common-mode to common-mode return loss requirements were left to be determined in the adopted baseline proposal. Contributions in this area are encouraged.

The measurement bandwidth for other specifications is addressed by comment #60, which was resolved with a bandwidth of 60 GHz.

It seems that specifications of Tx RLcc should be within the same bandwidth.

Editorial team proposal:
Accept #232.
Resolve #242 using the response to comment #60.

Cl **178**	*SC* **178.9.2**	*P* **276**	*L* **20**	#	232

Li, Mike — Intel

Comment Type **TR** *Comment Status* **X**

RLcc (min) is TBD

SuggestedRemedy

Change it to 3.25 dB. See lim_3dj_01_2403a.

Proposed Response *Response Status* **O**

Annex 176E

Annex 176E, C2M channel ILdd Comments #129, #130, #73, #134

Done

Cl **176E** *SC* **176E.2** *P* **615** *L* **23** # 129

Ghiasi, Ali — Ghiasi Quantum/Marvell

Comment Type **T** *Comment Status* **X**

Figure depicts loss should be bump-bump

SuggestedRemedy

...application and the associated ILdd bump-bump budget at 53.125 GHz
To make it more clear Host C2M Component should be changed to Host C2M Device and Module C2M Device

Proposed response

Cl **176E** *SC* **176E.2** *P* **615** *L* **33** # 130

Ghiasi, Ali — Ghiasi Quantum/Marvell

Comment Type **T** *Comment Status* **X**

Loss budgets are TBD

SuggestedRemedy

See Ghiasi C2M May-24 Contribution for background on the numbers
IIDD=28 dB
Connector with one via = 3 dB
Module Ildd = 3.6 dB
Host Ildd=21.4 dB

Cl **176E** *SC* **176E.4.1** *P* **632** *L* **6** # 73

Lusted, Kent — Intel Corporation

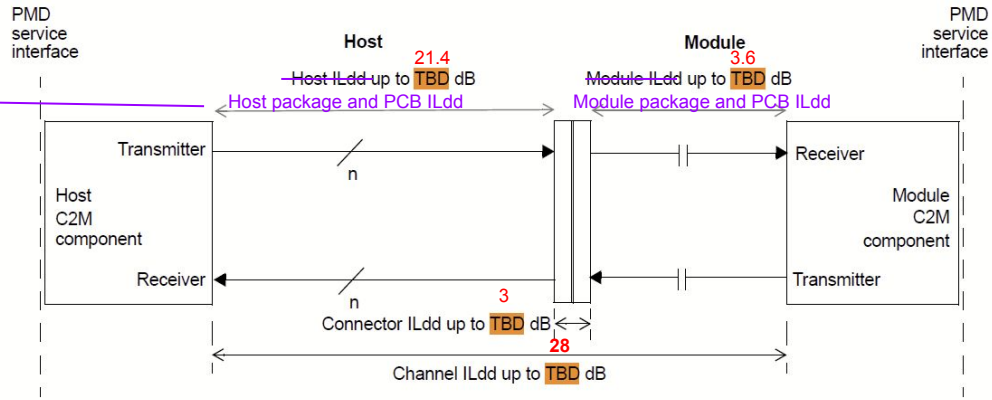
Comment Type **TR** *Comment Status* **X**

The IL_dd for AUI C2M channel is a TBD

SuggestedRemedy

Set IL_dd = 33 per https://www.ieee802.org/3/dj/public/24_01/lusted_3dj_03_2401.pdf

Proposed Response *Response Status* **O**



NOTE—The number of lanes n is equal to 1 for 200GAUI-1, 2 for 400GAUI-2, 4 for 800GAUI-4, and 8 for 1.6TAUI-8.

Figure 176E–2—Components of a 200 Gb/s per lane AUI-C2M interface and insertion loss budget at 53.125 GHz

The referenced presentation is https://www.ieee802.org/3/dj/public/24_05/ghiasi_3dj_02a_2405.pdf.
It analyzes specific channels with unspecified module PCB loss and “8 mm CDR” module package.
Several COM parameters used in this presentation have not been adopted.

The referenced presentation is https://www.ieee802.org/3/dj/public/24_01/lusted_3dj_03_2401.pdf.
The comment is against 176E.4.1 (Recommended channel characteristics/Insertion loss), which has an equation for the ILdd limit. The suggested remedy does not address the equation.
The proposed value for this TBD (Channel ILdd) is **33 dB.**
Comment #134 suggests **28 dB** for the same TBD.

Editorial team proposal:
Reject #130, #73 and #134 due to the large difference. Continue working toward consensus loss budget for C2M in conjunction with COM parameters.

Annex 176E, Input specs (#188, #189)

Done

Cl 176E SC 176E.3.5 P624 L3 # 188

Ran, Adee Cisco

Comment Type TR *Comment Status* X

Host input characteristics need to be defined with consideration of the availability of training.

This will affect the entire subclause 176E.3.5.

SuggestedRemedy

Define the input characteristics using a methodology similar to that of receiver specifications in 179.9.5, with the required changes due to the lack of a cable assembly.

Use a table similar to Table 179-10 but with additional rows for DC common-mode voltage and AC common-mode voltage tolerance.

A detailed proposal will be provided.

Proposed Response *Response Status* O

Cl 176E SC 176E.3.6 P628 L26 # 189

Ran, Adee Cisco

Comment Type TR *Comment Status* X

Module input characteristics need to be defined with consideration of the availability of training.

This will affect the entire subclause 176E.3.6.

SuggestedRemedy

Define the input characteristics using a methodology similar to that of receiver specifications in 179.9.5, with the required changes due to the lack of a cable assembly and usage of MCB instead of HCB.

Use a table similar to Table 179-10 but with additional rows for DC common-mode voltage tolerance and AC common-mode voltage tolerance.

A detailed proposal will be provided.

Proposed Response *Response Status* O

The detailed proposal mentioned is https://www.ieee802.org/3/dj/public/24_05/ran_3dj_01_2405.pdf.

The presentation addressed both host input and module input, and proposes using a methodology based on the CR Amplitude tolerance, Interference tolerance, and Jitter tolerance tests for these specifications, with appropriate changes to the host/module test setups.

The specific proposals are on slides 6-9 of the referenced presentation.

The following straw poll was taken in the May 2024 interim meeting:

Straw Poll #2
I would support the approach for the AUI-C2M host and module input specifications outlined in ran_3dj_01_2405
Results (all) Y: 31, N: 15, NMI: 6, A: 39

The results show significant support for using the CR methodology for AUI-C2M host and module input specs.

Note that https://www.ieee802.org/3/dj/public/24_06/dawe_3dj_01a_2406.pdf seems to oppose this direction, but no other comments related to input specifications were submitted.

Editorial team proposal:
Implement the proposed changes on slides 6-9 of ran_3dj_01_2405 with editorial license.

Annex 176E, Output specs (#186, #187, #203)

Done

Cl 176E SC 176E.3.3 P617 L10 # 186

Ran, Adee Cisco

Comment Type TR *Comment Status* X

Host output characteristics need to be defined with consideration of the variable output settings that can result from training.

This will affect the entire subclause 176E.3.3.

SuggestedRemedy

Define the output characteristics using a methodology similar to that of transmitter specifications in 179.9.4.

Use a table similar to Table 179-7 but with different values due to the higher host channel insertion loss budget for C2M.

A detailed proposal will be provided.

Proposed Response *Response Status* O

Cl 176E SC 176E.3.4 P621 L13 # 187

Ran, Adee Cisco

Comment Type TR *Comment Status* X

Module output characteristics need to be defined with consideration of the variable output settings that can result from training.

This will affect the entire subclause 176E.3.4.

SuggestedRemedy

Define the output characteristics using a methodology similar to that of transmitter specifications in 179.9.4.

Use a table similar to Table 179-7 but with different values due to the lower insertion loss assumed for the module output test.

A detailed proposal will be provided.

Proposed Response *Response Status* O

Cl 176E SC 176E.5 P633 L12 # 203

Ran, Adee Cisco

Comment Type TR *Comment Status* X

Measurement methodology for C2M should consider the variable output settings that can result from training. Eye opening parameters with specific transmitter settings are not the relevant metrics for transmitter quality anymore.

The measurement methodology of CR transmitter, which focuses on training-related equalizer parameters and training-independent signal parameters, is more suitable.

SuggestedRemedy

Move the measurement methodology section into another annex that both Clause 179 and Annex 176E can refer to.

A detailed proposal will be provided.

Proposed Response *Response Status* O

The detailed proposal mentioned is https://www.ieee802.org/3/dj/public/24_05/ran_3dj_02_2405.pdf.

The presentation addressed both host output and module output, and proposes using the CR methodology for these specifications (instead of VEC/EH measurements) and rewriting the “Measurement methodology” section 176E.5. The specific proposals are on slides 6, 8, 10, and 11.

Annex 176E, Output specs (#65, #132, #139, #365, #522)

Done

Rewriting 176E.5 as proposed would remove the “Eye opening reference receiver parameter values” table (Table 176E–7), which is the subject of several comments.

Comment #132 about the EH/VEC values will be OBE if the CR methodology is adopted.

Cl **176E** SC **176E.5.2** P**633** L**39** # 365

Healey, Adam — Broadcom Inc.

Comment Type **T** *Comment Status* **X**

The title of Table 176E-7 suggests that is should contain reference receiver parameters. Many of the parameters in the table are not relevant to a reference receiver or an eye diagram measurement. It is understood that this may become moot if a different test method is adopted, but until this decision is made the table can be trimmed down to remove "TBDs" that will never need to be defined.

SuggestedRemedy

Remove parameters "maximum start frequency", "maximum frequency step", all "transmitter" parameters including "number of signal levels" and "level separation mismatch ratio", "number of samples per unit interval", and "target detector error ratio". It is also questionable whether device termination and package model parameters are needed (they were not used in Annex 120G).

Proposed Response *Response Status* **O**

Cl **176E** SC **176E.5.2** P**634** L**8** # 65

Dudek, Mike — Marvell

Comment Type **T** *Comment Status* **X**

There shouldn't be any Tx parameters in a specification for a reference receiver.

SuggestedRemedy

Delete the rows for transmitter termination resistance, transmitter equalizer coefficients, transmitter differential peak output voltage, transition time, transmitter signal to noise ratio, RLM,

Proposed Response *Response Status* **O**

Cl **176E** SC **176E.3.3** P**617** L**35** # 132

Ghiasi, Ali — Ghiasi Quantum/Marvell

Comment Type **T** *Comment Status* **X**

Eye height and VEC are TBD

SuggestedRemedy

See Ghiasi C2M May-24 Contribution for background on the numbers
VEC=10.7 dB
VEO=8 mV

Proposed Response *Response Status* **O**

Cl **176E** SC **176E.5.2** P**634** L**50** # 139

Ghiasi, Ali — Ghiasi Quantum/Marvell

Comment Type **T** *Comment Status* **X**

Jitter and noise parameters are TBD

SuggestedRemedy

See Ghiasi C2M May-24 Contribution for background on the numbers
Eta0=1.25E-8
Transmitter SNR = NA for reference receiver but may use 33 dB for COM code
Transmitter Sigma = NA for reference receiver but may use 0.01 UI for COM code
Transmitter dual-Dirac jitter = NA for reference receiver but may use 0.02 UI for COM code
Transmitter RLM = NA for reference receiver but may use 95% for COM code

Proposed Response *Response Status* **O**

Cl **176E** SC **176E.5.2** P**633** L**33** # 522

Dawe, Piers — Nvidia

Comment Type **T** *Comment Status* **X**

decision-feedback equalizer? The table mentions "feed-forward coefficient"

SuggestedRemedy

Update this text

Proposed Response *Response Status* **O**

Annex 176E, Output specs

Done

The following straw poll was taken in the May 2024 interim meeting:

Straw Poll #3
I would support the approach for the AUI-C2M host and module output specifications outlined in ran_3dj_02_2405
Results (all): Y: 38, N: 9, NMI: 9, A: 42

The results show significant support for using the CR methodology for AUI-C2M host and module output specs.

Note that https://www.ieee802.org/3/dj/public/24_06/dawe_3dj_01a_2406.pdf seems to oppose this direction.

Editorial team proposal:

- In response to #186, AIP: implement the proposed changes on slides 6, 8, 10, and 11 of ran_3dj_02_2405 with editorial license, except that for jitter values use the values adopted by comment #204.
- For #187 and #203, AIP: resolve using the response to #186.
- For #65, #139, #365, and #522, AIP: the text subject of the comment will be replaced by the response to #186.
- #132: AIP, the specification is replaced by the response to #186.

Annex 178A

Annex 178A, DER0 (1 of 2) Comments #285, #362

Done

Cl 178A SC 178A.1.10.2 P659 L12 # 285

Li, Mike Intel

Comment Type TR *Comment Status* X

DER0 EQ is wrong

SuggestedRemedy

change P(y0)= DER0 to 1-P(y0) =DER0, see slide 3 of lim_3dj_02_2405, see also a marked version in the support data sheet.

Proposed Response *Response Status* O

Cl 178A SC 178A.1.10 P658 L43 # 362

Healey, Adam Broadcom Inc.

Comment Type T *Comment Status* X

The relationship between "detector error ratio", "PAM-L symbol error ratio", and "bit error ratio" is not documented and, as a result, not generally understood. While these quantities are related, they are not interchangeable. Prior assumptions that they are interchangeable has led to errors in the translation between COM results and expected (measured) receiver performance. This new annex gives us an opportunity to clarify the relationship between DER0 and other terms or to replace DER0 with a more generally understood term.

SuggestedRemedy

Slide 5 of <https://www.ieee802.org/3/dj/public/23_11/healey_3dj_01a_2311.pdf> suggest expressions for relationship between detector error ratio and other terms. Either replace "DER0" with a target PAM-4 symbol error ratio (or bit error ratio) and adjust the equations for calculating COM accordingly, or document the relationship between DER0 and the other two terms.

Proposed Response *Response Status* O

It may not be clear that the solution for $y_0 = P^{-1}(DER_0)$ is less than 0 for any $DER_0 < 0.5$

It is specified that the magnitude of the result is used

Expressions like $y_0 = P^{-1}(1-DER_0)$ or $DER_0 = 1-P(y_0)$ are used elsewhere in Annex 178A to make y_0 greater than 0

Although also correct, use of different forms may lead to further confusion

It would be better to add clarity to, and consistently use, an expression to map between a CDF value and the corresponding amplitude value

In addition, there has been confusion about the relationship between DER_0 and PAM-L symbol error ratio (or BER) and it has been suggested that this relationship be clarified

Annex 178A, DER0 (2 of 2) Comments #285, #362

Done

Editorial team proposal:
Implement the changes shown in this slide, with editorial license.

178A.1.10.2 Noise and interference amplitude

The probability distribution function of the noise and interference amplitude is calculated using the procedure defined in 93A.1.7.3 using the sampled time-domain responses and noise variance defined in 178A.1.9. The corresponding cumulative distribution function is defined by Equation (178A–35).

$$P(y) = \int_{-\infty}^{y} p(u)du$$ [Use dummy variable in integrand.] (178A–35)

[Re-write to clarify that the expected result is a positive number.]

The noise and interference amplitude, A_{ni}, is a positive value that satisfies the relationship $P(-A_{ni}) = DER_0$ where DER_0 is the target detector error ratio.

[Add note to clarify the relationship between DER and other error ratio metrics.]

NOTE 2—The target detector error ratio DER_0 is SER_1 x $L/(2L-2)$ where SER_1 is the maximum allowed probability of the initial error in a PAM-L error burst.

[Change Equations (178A–36) and (178A–37), as modified by comments #211, #212, #286, and #287, to use expressions similar to what is used in 178A.1.10.2.]

$$COM_{MLSD} = COM_{DFE} + 20\log_{10}(-P^{-1}(DER_{MLSD})/A_s) - Q \quad (178A–36)$$

$$DER_{MLSD} = \sum_{j=1}^{\infty}\left(\frac{L-1}{L}\right)^{j-1} P_j\left(-A_s\frac{(u_j^T u_j)^{3/2}}{(u_j^T V_j u_j)^{1/2}}\right) \quad (178A–37)$$

Clause xxx, <topic>
Comment #<n>